CERTIFICATE OF TRANSLATION

I, SHUSAKU YAMAMOTO, patent attorney of Fifteenth Floor, Crystal Tower, 1-2-27 Shiromi, Chuo-ku, Osaka 540-6015, Japan HEREBY CERTIFY that I am acquainted with the English and Japanese languages and that the attached English translation is a true English translation of what it purports to be, a translation of Japanese Laid-open Utility Model Publication No. 3-113986, entitled "DC-DC Converter", laid-opened on November 21, 1991.

Additionally, I verify under penalty of perjury under the laws of the United States of America that the foregoing is true and correct.

Executed this 11th day of June, 1998.

SHUSAKU YAMAMOTO

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Your Ref: 02445.037

Translation of Japanese Laid-Open Utility Model Publication

Laid-Open Utility Model Publication Number: 3-113986
Laid-Open Publication Date: November 21, 1991
Title of the Invention: DC-DC CONVERTER
Utility Model Application Number: 2-23488
Filing Date: March 8, 1990
Inventor: M. FURUYA
Applicant: MITSUMI ELECTRIC CO., LTD.

1. TITLE OF THE UTILITY MODEL

DC-DC CONVERTER

2. CLAIM

A DC-DC converter for obtaining an output voltage at a predetermined level by making control means, which controls a switching of a switching element, control ON/OFF periods of the switching element in accordance with the level of the output voltage, comprising:

switch means for turning ON/OFF a power supplied to the control means; and

detection means for detecting the level of the output voltage and controlling the switch means such that the switch means is turned OFF when the level of the output voltage exceeds a predetermined value.

3. DETAILED DESCRIPTION OF THE UTILITY MODEL

FIELD OF THE UTILITY MODEL

The present utility model relates to a DC-DC converter, and more particularly relates to a DC-DC converter for obtaining an output voltage at a predetermined level from an input voltage by controlling the switching of a switching element in accordance with the level of the output voltage.

PRIOR ART

A circuit diagram showing the configuration of a conventional DC-DC converter is shown in Figure 4.

As shown in Figure 4, the conventional DC-DC converter includes: an input voltage source 2 which supplies a power to be converted; a switching element Q_1 for controlling the switching of the supplied current; a control means 1 for controlling the switching element; a coil L_1 for smoothing and rectification; a diode D_1; a capacitor C_1; and a voltage detection circuit 13 for detecting an output voltage.

The voltage detection circuit 13 includes: an operational amplifier 14; a current source 15; a Zener diode D_3; and resistors R_7 and R_8. A voltage to be generated between output terminals 7a and 7b is divided by the resistors R_7 and R_8, and the divided voltage is compared by the operational amplifier 14 with a reference voltage to be generated by the current source 15 and the Zener diode D_3, thereby outputting the voltage difference therebetween.

The control means 1 includes a triangular wave generator circuit 3 and a pulse width modulator circuit 4. The pulse width modulator circuit 4 is provided with not only a triangular wave signal from the triangular wave generator circuit 3, but also a detection signal from the voltage detection circuit 13 in accordance with the output voltage. The pulse width modulator circuit 4 generates a pulse signal having a pulse width corresponding to the output voltage from these signals, and then supplies this

pulse signal to the base of an NPN transistor or the switching element Q_1 via a resistor R_1.

The switching of the NPN transistor Q_1 is controlled in response to the pulse signal, having a pulse width corresponding to the output voltage, from the control means 1. When the switching of the NPN transistor Q_1 is controlled, energy is exchanged between the coil L_1 and the capacitor C_1 via the diode D_1, thereby obtaining an output voltage at a predetermined level.

In this case, a power is continuously supplied to the control means 1 in such a conventional DC-DC converter.

PROBLEMS TO BE SOLVED BY THE UTILITY MODEL

However, in such a conventional DC-DC converter, a power is continuously supplied to the control means which controls the switching element, and current continuously flows even in a standby mode in which no load is connected to the converter. Thus, the conventional DC-DC converter operates a circuit in a region where the operation of the circuit is not required, and consumues power for nothing. Consequently, the power consumed by such a converter is adversely increased.

In view of the above-described problems, the present utility model has been devised for the purpose of providing a DC-DC converter allowing for reduced power consumption.

MEANS FOR SOLVING THE PROBLEMS

The present utility model is a DC-DC converter for obtaining an output voltage at a predetermined level by making control means, which controls the ON/OFF of an input voltage, control ON/OFF periods of the input voltage in accordance with the level of the output voltage, including: switch means for turning ON/OFF a power supplied to the control means; and detection means for detecting the level of the output voltage and controlling the switch means such that the switch means is turned OFF when the level of the output voltage exceeds a predetermined value.

FUNCTION

The switch means turns ON/OFF the supply of a power to the control means for holding the output voltage at a constant level by controlling the ON/OFF states of the switching element. The ON/OFF states of the switch means are controlled by the detection means. The detection means detects the level of the output voltage, and controls the switch means such that the switch means is turned OFF when the level of the output voltage exceeds a predetermined value.

Consequently, in a region where the control means need not control the output voltage, the switch means is turned OFF and no power is supplied to the control means.

EXAMPLE

Figure 1 is a circuit diagram showing a configuration of the present utility model.

In this example, the present utility model is applied to a forward converter.

A control means 1 includes: a triangular wave generator circuit 3; a pulse width modulator circuit 4; an NPN transistor Q_1; and a resistor R_1. The triangular wave generator circuit 3 and the pulse width modulator circuit 4 are connected to an input voltage source 2 via a switch means 5 and are operated by the input voltage source 2.

The triangular wave signal output by the triangular wave generator circuit 3 is supplied to the pulse width modulator circuit 4. The pulse width modulator circuit 4 outputs pulse signals having pulse widths which are varied in accordance with the triangular wave signal from the triangular wave generator circuit 3 and a detection signal from a load current detection circuit 6.

The pulse signal output by the pulse width modulator circuit 4 is supplied to the base of the NPN transistor Q_1 via the resistor R_1. The collector of the NPN transistor Q_1 is connected to the anode of the input voltage source 2 via the smoothing coil L_1, while the emitter of the NPN transistor Q_1 is connected to the cathode of the input voltage source 2.

The connection point between the smoothing coil L_1 and the NPN transistor Q_1 is connected to the output terminal 7a via the rectifying diode D_1 and the resistor R_2 as a component of the load current detection circuit 6. The load current detection circuit 6 includes the resis-

tor R_2 and an operational amplifier 8. In this circuit, the potential difference between the terminals of the resistor R_2 is detected by the operational amplifier 8. The detection signal output by the operational amplifier 8 is supplied to the pulse width modulator circuit 4. In response to this signal, the pulse width modulator circuit 4 varies the pulse width of the output pulse signal.

A ripple filtering capacitor C_1 is connected between the connection point of the diode D_1 and the resistor R_2, and the output terminal 7b.

The switching of the switch means 5 is controlled in response to a switching signal from the detection means 9. The detection means 9 includes: a constant current source 10; a Zener diode D_z; resistors R_3, R_4, R_5 and R_6; and a comparator 11.

A reference voltage is generated by the Zener diode D_z and the constant current source 10, and is input to the comparator 11 via the current limiting resistor R_3. The resistor R_6 feedbacks the voltage, thereby providing hysteresis characteristics for the comparator 11. A divided voltage corresponding to the output voltage of the connection point between the diode D_1 and the resistor R_2 is produced by the resistors R_4 and R_5, and is input to the comparator 11. The comparator 11 compares the level of the reference voltage with the level of the divided voltage, thereby outputting a pulse signal. When the level of the divided voltage becomes lower than that of the reference voltage, the switch means 5 is turned OFF, in response to

a pulse signal from the comparator 11. Consequently, the power is not supplied to the triangular wave generator circuit 3 and the pulse width modulator circuit 4. The comparator 11 has hysteresis characteristics, thereby stabilizing the operation of the circuit. Not only a ripple filtering capacitor C_2 but also a load 12 are connected between the output terminals 7a and 7b.

Next, the operation of the circuit will be described with reference to Figure 2.

First, assuming that the input voltage source 2 is energized and power is supplied at a time t_0, a reference voltage is applied to the comparator 11. Since the level of a divided voltage is lower than that of the reference voltage, the switch means is turned ON, power is supplied to the triangular wave generator circuit 3 and the pulse width modulator circuit 4, and the triangular wave generator circuit 3 and the pulse width modulator circuit 4 are operated. The power is also supplied to the operational amplifier 8 and the operational amplifier 8 is also operated. As a result, the output voltage V_{out} between the output terminals 7a and 7b increases.

Next, when the voltage V_1 obtained by dividing the voltage V_{c1} corresponding to the output voltage V_{out} becomes higher than a reference voltage V_{ref1} determined beforehand by the constant current source 10, the Zener diode D_z and the resistor R_6 at a time t_1, the polarity of the pulse signal output by the comparator 11 changes and the switch means 5 is turned OFF. Subsequently, when the voltage V_1

corresponding to the output voltage V_{out} becomes smaller than a reference voltage V_{ref2} determined beforehand by the constant current source 10 and the resistors R_3 and R_6 at a time t_2, the polarity of the pulse signal output by the comparator 11 is inverted again, thereby turning ON the switch means 5. As can be seen, when the output voltage V_{out} exceeds a required value, no power is supplied to the triangular wave generator circuit 3 and the pulse width modulator circuit 4. Thus, since unnecessary current does not flow, the power consumption can be reduced.

Furthermore, in the case where the voltage V_1 varies among the voltages lower than the reference voltage V_{ref1} determined by the constant current source 10 and the resistors R_3 and R_6 between times t_3 and t_4, the pulse width modulator circuit 4 is controlled by the output signal of the load current detection circuit 6 including the resistor R_2 and the operational amplifier 8 and the pulse width of the pulse signal output by the pulse width modulator circuit 4 is controlled, thereby holding the output voltage V_{out} at a constant level. The pulse width of the pulse signal output by the pulse width modulator circuit 4 for controlling the output voltage V_{out} is controlled in accordance with the amount of load current flowing through the load 12. Consequently, an overdrive can be prevented even when the load is light. Moreover, since current does not flow through the detecting resistor R_4 when no load exists, the power consumption can also be reduced.

Figure 3 is a circuit diagram showing a configu-

ration of another example of the present utility model. In Figure 3, the same components as the counterparts in Figure 1 will be identified by the same reference numerals and the description thereof will be omitted herein.

In this example, the present utility model is applied to a down converter. A controlling transistor is implemented as a PNP transistor Q_2, the PNP transistor Q_2 and a ripple filtering coil L_2 are serially connected to an input/output line, and a rectifying diode D_2 and a ripple filtering capacitor C_3 are connected between the output terminals 7a and 7b. The output voltage V_{out} becomes smaller than an input voltage V_{in}.

EFFECT OF THE UTILITY MODEL

As is apparent from the foregoing description, according to the present utility model, the ON/OFF states of a power supply for operating a control means, which controls the switching of a switching element, are controlled by a switch means, in response to a detection signal from a detection means which detects the level of an output voltage and outputs the detection signal in accordance with the level. Consequently, in a region where it is not necessary to control the switching by the control means, power need not be supplied to the control means, thereby advantageously reducing power consumption considerably.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a circuit diagram showing a configuration of an example of the present utility model; Figure 2

is a waveform chart illustrating the operation in the example of the present utility model; Figure 3 is a circuit diagram showing a configuration of another example of the present utility model; and Figure 4 is a circuit diagram showing a configuration of a conventional example.

1: control means; 2: input voltage source; 5 switch means; 6: load current detection circuit; and 9: detection means.

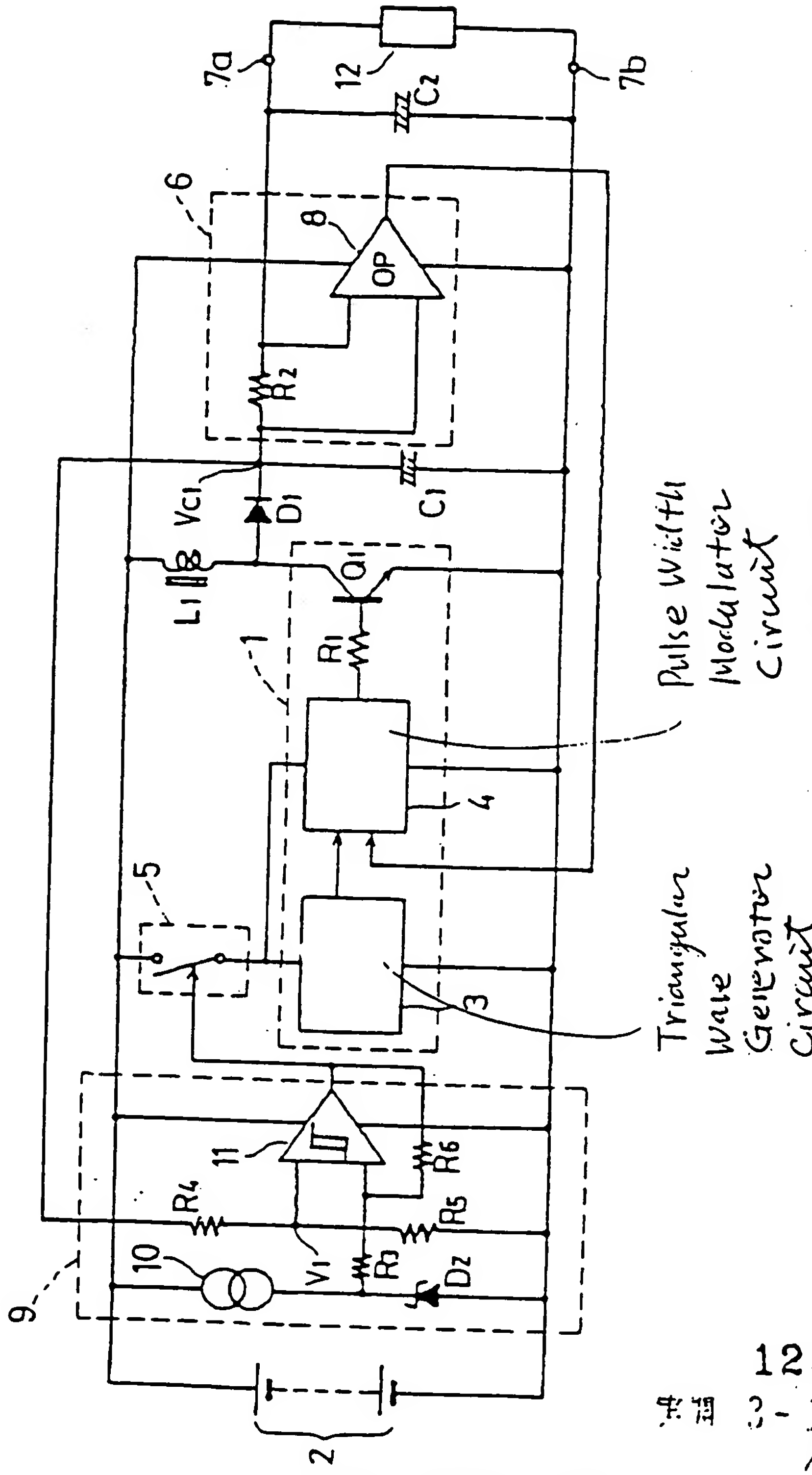

FIG. 1

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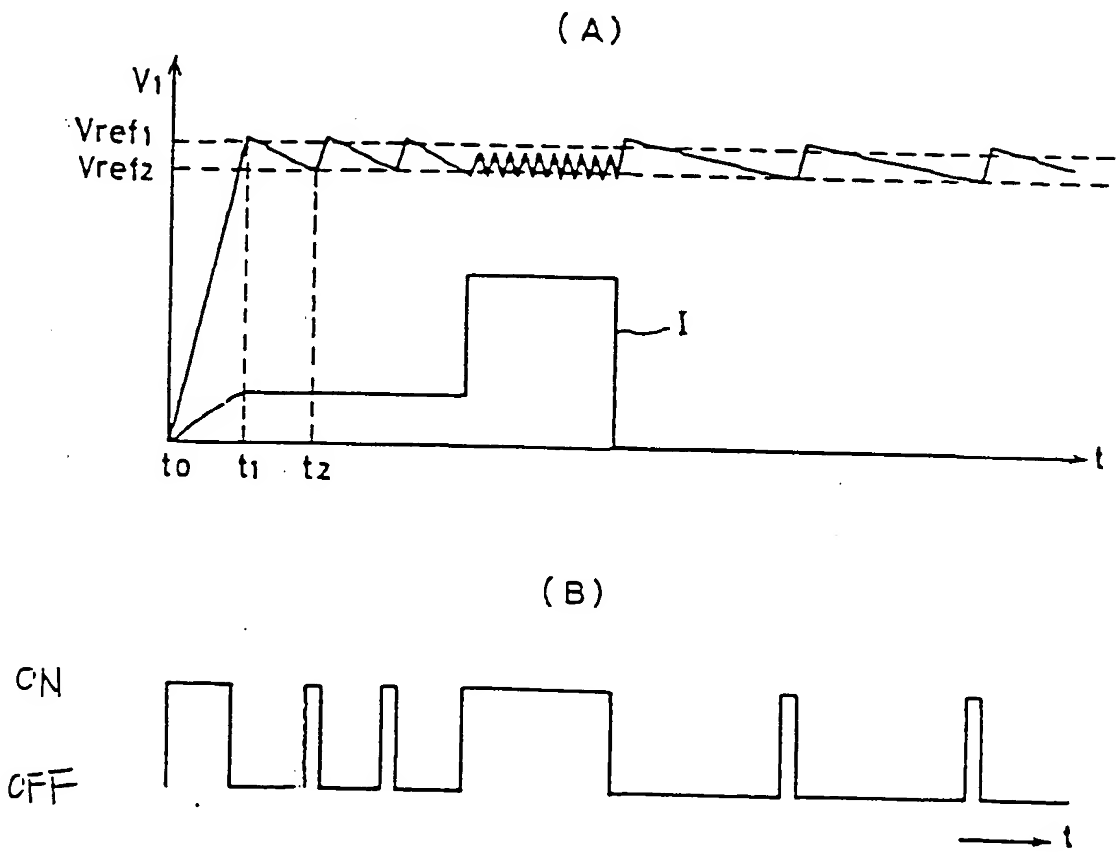
FIG. 2



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実開 3-11[illegible]

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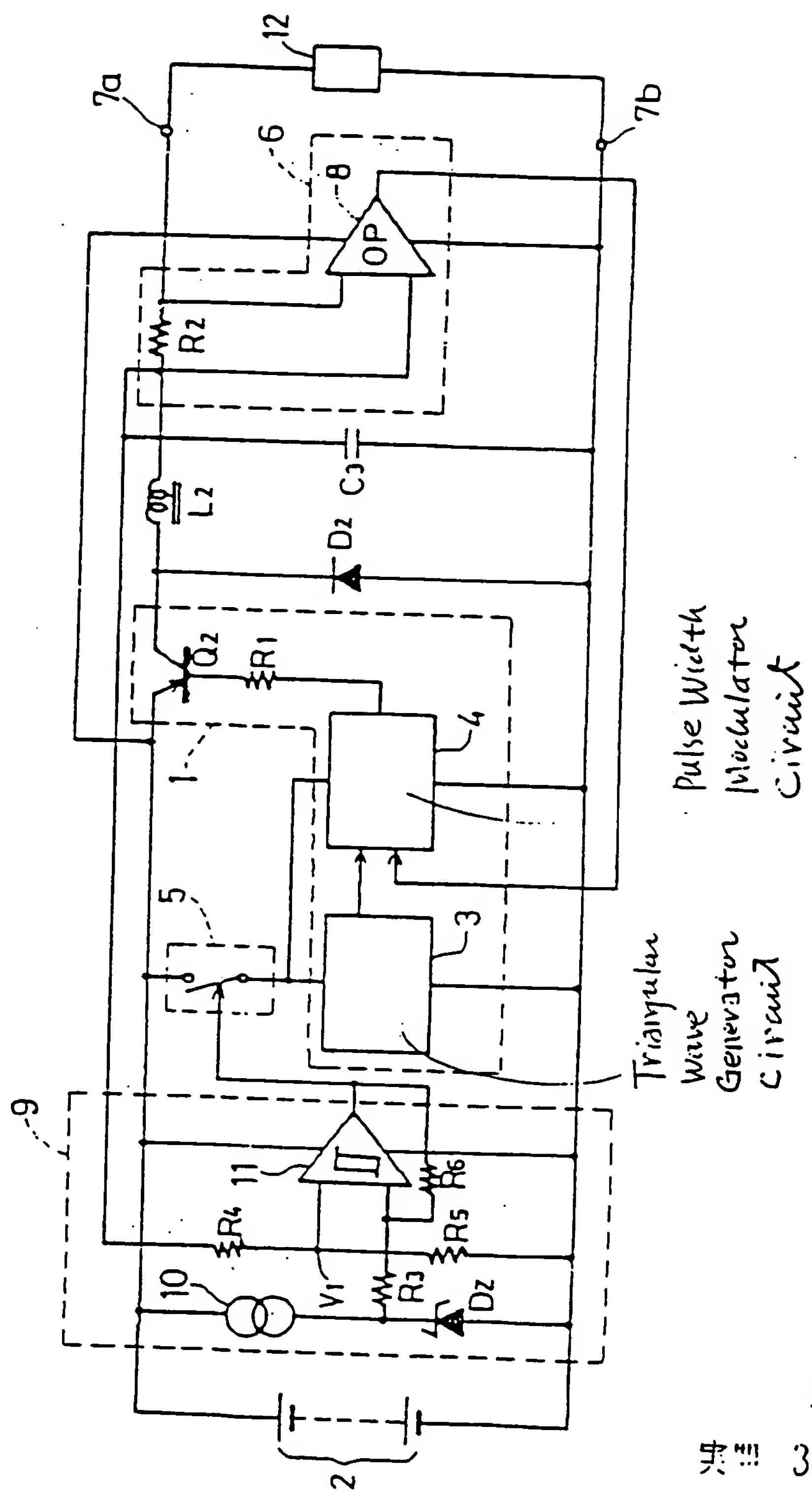
FIG.3



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実開3

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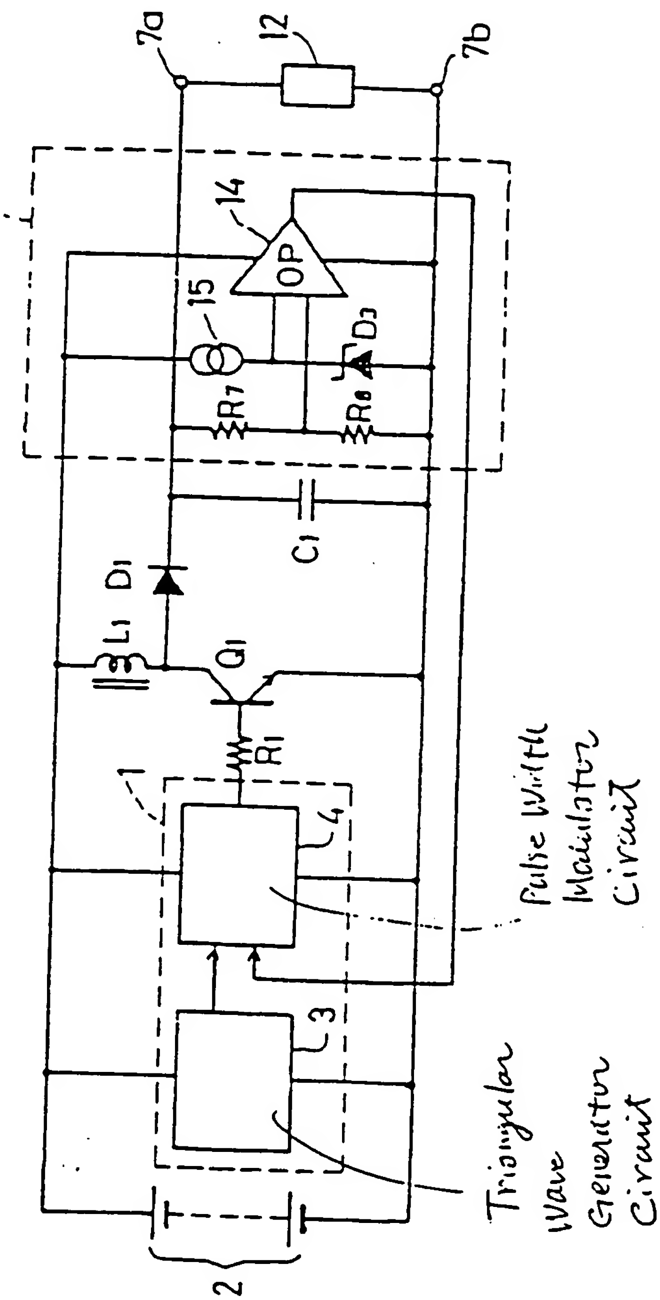

FIG.4

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H 02 M 3/155　H 7829－5H
X 7829－5H

審査請求　未請求　請求項の数　１　（全２頁）

㊹考案の名称　直流－直流コンバータ

㉑実　願　平2－23488
㉒出　願　平２(1990)３月８日

㊷考案者　古谷　操　神奈川県伊勢原市沼目５－25－９
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㊹代理人　弁理士　伊東　忠彦　外１名

㊲実用新案登録請求の範囲

スイッチング素子をスイッチング制御する制御手段により出力電圧レベルに応じて該スイッチング素子をオン・オフする期間を制御することにより所定レベルの出力電圧を得る直流－直流コンバータにおいて、

前記制御手段への電源の供給をオン・オフするスイッチ手段と、

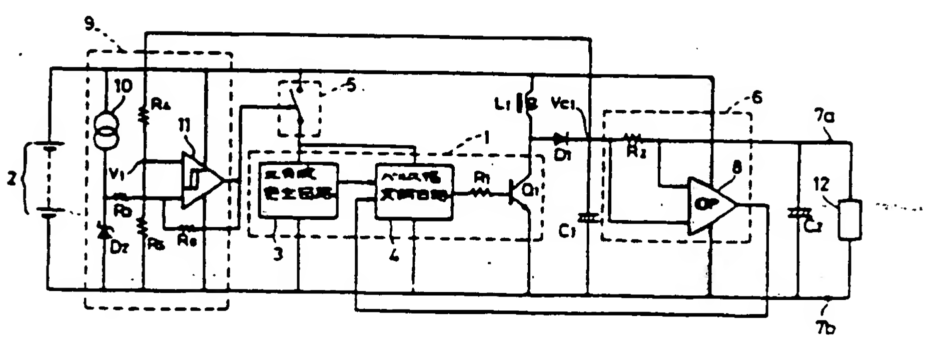
前記出力電圧レベルを検出し、前記出力電圧レベルが予め決められた所定の値を越えたときに前記スイッチ手段がオフとなるように前記スイッチ手段を制御する検出手段とを具備してなる直流－直流コンバータ。

図面の簡単な説明

第１図は本考案の一実施例の回路構成図、第２図は本考案の一実施例の動作を説明するための波形図、第３図は本考案の他の実施例の回路構成図、第４図は従来の一例の回路構成図である。

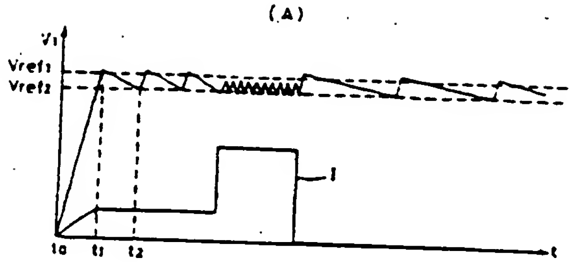
１……制御手段、２……入力電圧源、５……スイッチ手段、６……負荷電流検出回路、９……検出手段。

第１図

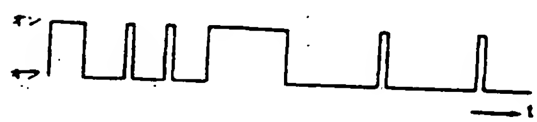


第 2 図

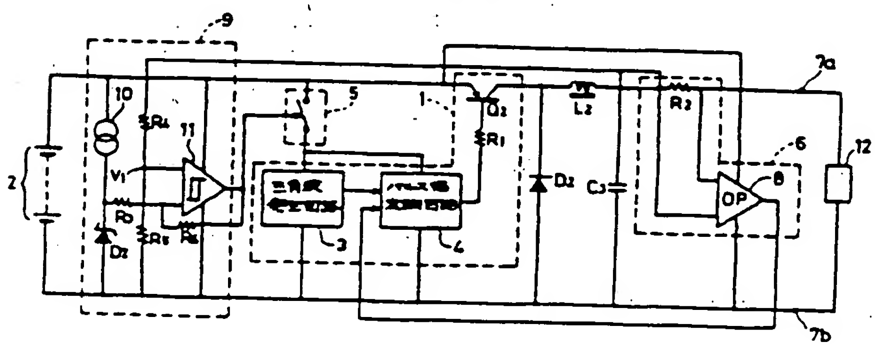
(A)



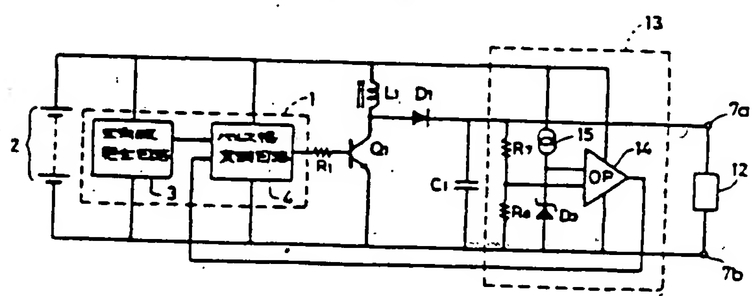
(B)



第 3 図



第 4 図



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